



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/605,369	09/25/2003	Lloyd G. Burrell	FIS920030011US1	2368
32074	7590	10/13/2004	EXAMINER	
INTERNATIONAL BUSINESS MACHINES CORPORATION			MAI, ANH D	
DEPT. 18G			ART UNIT	
BLDG. 300-482			2814	
2070 ROUTE 52			PAPER NUMBER	
HOPEWELL JUNCTION, NY 12533			DATE MAILED: 10/13/2004	

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/605,369	BURRELL ET AL.	
	Examiner	Art Unit	
	Anh D. Mai	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 September 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 15-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-14 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 04 February 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>9/25/2003 and 12/19/003</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. During a telephone conversation with Mr. Ira D. Blecker, Reg. No. 29,894 on October 05, 2004 a provisional election was made with traverse to prosecute the invention of Group I semiconductor device, claims 1-14. Affirmation of this election must be made by applicant in replying to this Office action. Claims 15-20 have been withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Specification

2. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested:

CONTACT PAD HAVING A COMPOSITE LAYER IN ADDITION TO A BARRIER LAYER BETWEEN COPPER WIRING AND ALUMINUM BONDING PAD.

Drawings

3. The formal drawings were received on February 4, 2004. These drawings are acceptable.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Art Unit: 2814

4. Claim 6 is rejected under 35 U.S.C. 112, second paragraph, as failing to set forth the subject matter which applicant(s) regard as their invention. Evidence that claim 6 fail(s) to correspond in scope with that which applicant(s) regard as the invention can be found in the drawing Figs. 5 and 6. In these figures, the aluminum layer that is in direct contact with the barrier layer 30, 130 is the lower layer 24, 124, and this part of the disclosure ([0037]) indicates that the invention is different from what is defined in the claim(s) because only one aluminum layer (lower one), is in direct contact with the barrier layer not both (first and second layers) as recited in claim 6.

How can the top aluminum layer is in contact with the barrier layer 30, 130 ?

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1, 3, 4, 7-10 and 12 are rejected under 35 U.S.C. 102(b) as being anticipated by Applicant Admitted Prior Art (hereinafter AAPA).

AAPA teaches a semiconductor device as claimed including:

a semiconductor base (not shown);

at least one copper wiring level (123) on the semiconductor base;

a barrier layer (130) on, and in direct contact with, the copper wiring level (123);

an aluminum bond pad (124) on the barrier layer (130), and

a composite layer (not shown, as part of the barrier layer) in addition to the barrier layer (130) between the aluminum bond pad (124) and the barrier layer (130) wherein the composite layer comprises refractory metal (Ti) and a refractory metal nitride (TiN). (See [0031]-[0034]).

With respect to claim 3, the composite layer (Ti/TiN) of AAPA is directly on the barrier layer (TaN).

With respect to claim 4, the composite layer (Ti/TiN) of AAPA is within the aluminum bond pad (124).

With respect to claim 7, the barrier layer (130) of AAPA is selected from the group consisting of tantalum nitride, tantalum nitride/tantalum and tantalum nitride/titanium/titanium nitride.

With respect to claim 8, the thickness of the barrier layer of AAPA is 500 to 1000 Å.

With respect to claim 9, the refractory metal of the composite layer of AAPA is selected from the group consisting of titanium and the refractory metal nitride of the composite layer is selected from the group consisting of titanium nitride.

With respect to claim 10, the thickness of the aluminum bond pad (124) of AAPA is 0.5 to 2.0 μm.

With respect to claim 12, the refractory metal of the composite layer of AAPA is titanium and the refractory metal nitride is titanium nitride.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 2 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over AAPA as applied to claim 1 above, and further in view of Merchant et al. (U.S. Patent No. 6,410,986).

With respect to claim 2, AAPA teaches a composite layer comprises alternating layers of refractory metal (Ti) and refractory metal nitride (TiN).

Thus, AAPA is shown to teach all the features of the claim with the exception of explicitly disclosing that there are at least two layers of each refractory metal and refractory metal nitride.

However, Merchant teaches forming multi-layer structure to eliminate un-wanted diffusion of aluminum including: a composite layer comprises alternating layers of refractory metal (88) and refractory metal nitride (86) and there are at least two layers of each of the refractory metal (Ti) and refractory metal nitride (TiN). (See Fig. 5).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the composite layer of AAPA comprises at least two layers of each of the refractory metal and refractory metal nitride as taught by Merchant to eliminate un-wanted diffusion of aluminum.

Art Unit: 2814

With respect to claim 14, AAPA teaches the thickness of layer 30, 130 (TaN-Ti-TiN) may be in order of 500-1000 Å. Thus, AAPA is shown to teach all the features of the claim with the exception of explicitly disclosing the thickness of the composite layer (Ti-TiN). Note that the claimed thickness does not appear to be critical.

However, Merchant teaches: the number (as well as the thickness) of individual layers (of the composite layers $50_1, 50_2, \dots 50_N$) is considered to be a matter of design choice. (See col. 3, lines 45-62).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the composite layer of AAPA to a higher thickness as taught by Merchant to provide stress accommodation and robustness.

Further, the specification contains no disclosure of either the critical nature of the claimed *1000 Å thick* of any unexpected results arising therefrom. Where patentability is aid to based upon particular chosen thickness or upon another variable recited in a claim, the Applicant must show that the chosen dimension are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

7. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over AAPA as applied to claim 1 above, and further in view of Costrini et al. (U.S. Patent No. 6,187,680).

With respect to claim 5, AAPA teaches the aluminum bond pad (124) on the barrier layer (130). Thus, AAPA is shown to teach all the features of the claim with the exception of the aluminum bond pad comprises two layers and the composite layer is interposed between the first and second aluminum layers.

Art Unit: 2814

However, Costrini teaches an "Al stack" can be a combination of many layers including: Ti/TiN/AlCuSi/TiN, wherein the outer most layer contains aluminum or an alloy of aluminum. Thus, the composite layer is interposed between the first and second layers.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the bonding pad of AAPA having the composite layer interposes between the aluminum layers as taught by Costrini to significantly reduce the copper wiring from being exposed.

8. Claims 11 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over AAPA as applied to claim 1 above, and further in view of Besser et al. (U.S. Patent No. 6,239,494).

AAPA teaches the refractory metal and refractory metal nitride comprises Ti and TiN, respectively. Thus, AAPA is shown to teach all the features of the claim with the exception of alternatively using other refractory metal and refractory metal nitride.

However, Besser teaches it is well known in the art to use other refractory metal and refractory metal nitride such as Ta, W, TaN and WN, respectively, in place of Ti and TiN.

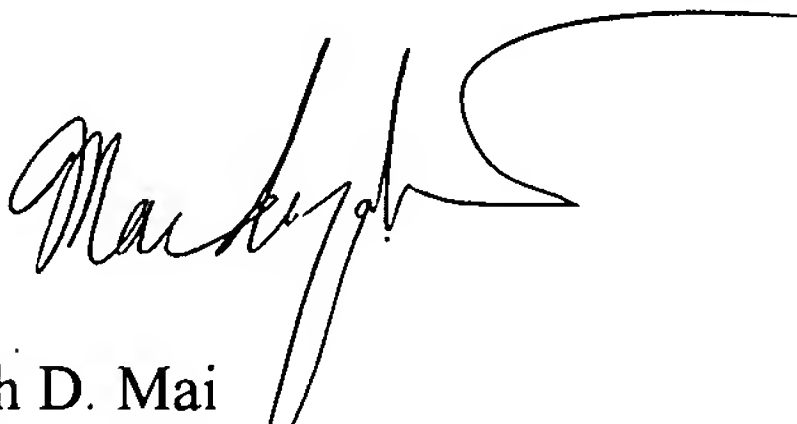
Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to alternatively using tantalum and tungsten and a nitride of these refractory in place of Ti and TiN of the AAPA as taught by Besser since these metal and their nitride have a similar characteristic of preventing diffusion of aluminum.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (571) 272-1710. The examiner can normally be reached on 9:00AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Anh D. Mai', with a long, sweeping horizontal line extending to the right.

Anh D. Mai
October 6, 2004